FINE SEDIMENT DYNAMICS AT THE REGIONAL SCALE

By

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Understanding fine sediment dynamics at the regional scale requires:

- **New morphodynamic models**
- **Sediment transport measurements to develop sediment budget - rates of inflow, outflow and accumulation/depletion**
- **Advanced laboratory techniques for understanding transport processes**

Consider open coast muddy beach dynamics:

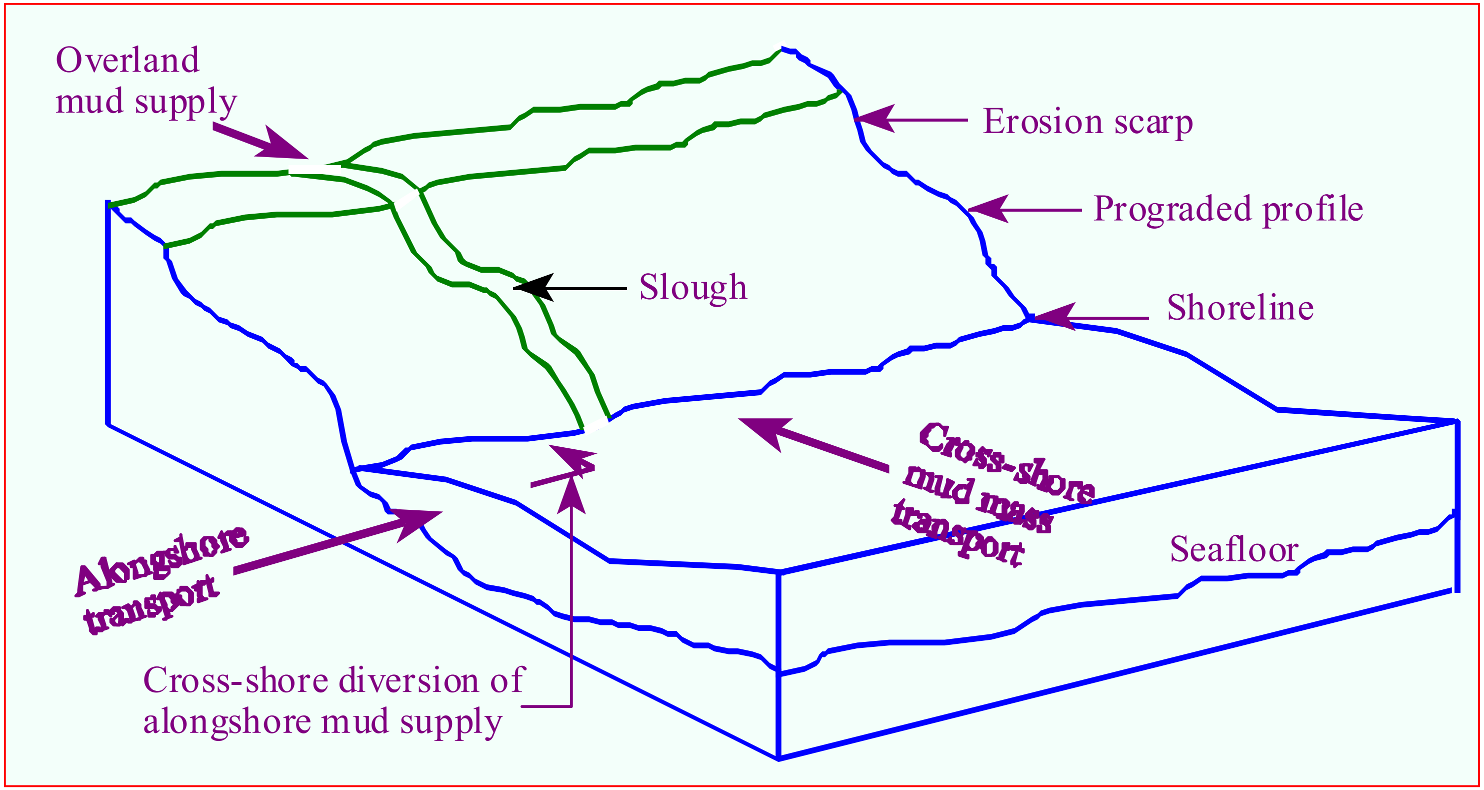

Figure 1 For coastal budgets both a longshore and cross-shore sediment fluxes must be known.

The simplest case is that of cross-shore beach profile changes due to shore-normal waves (= 180^{o}):

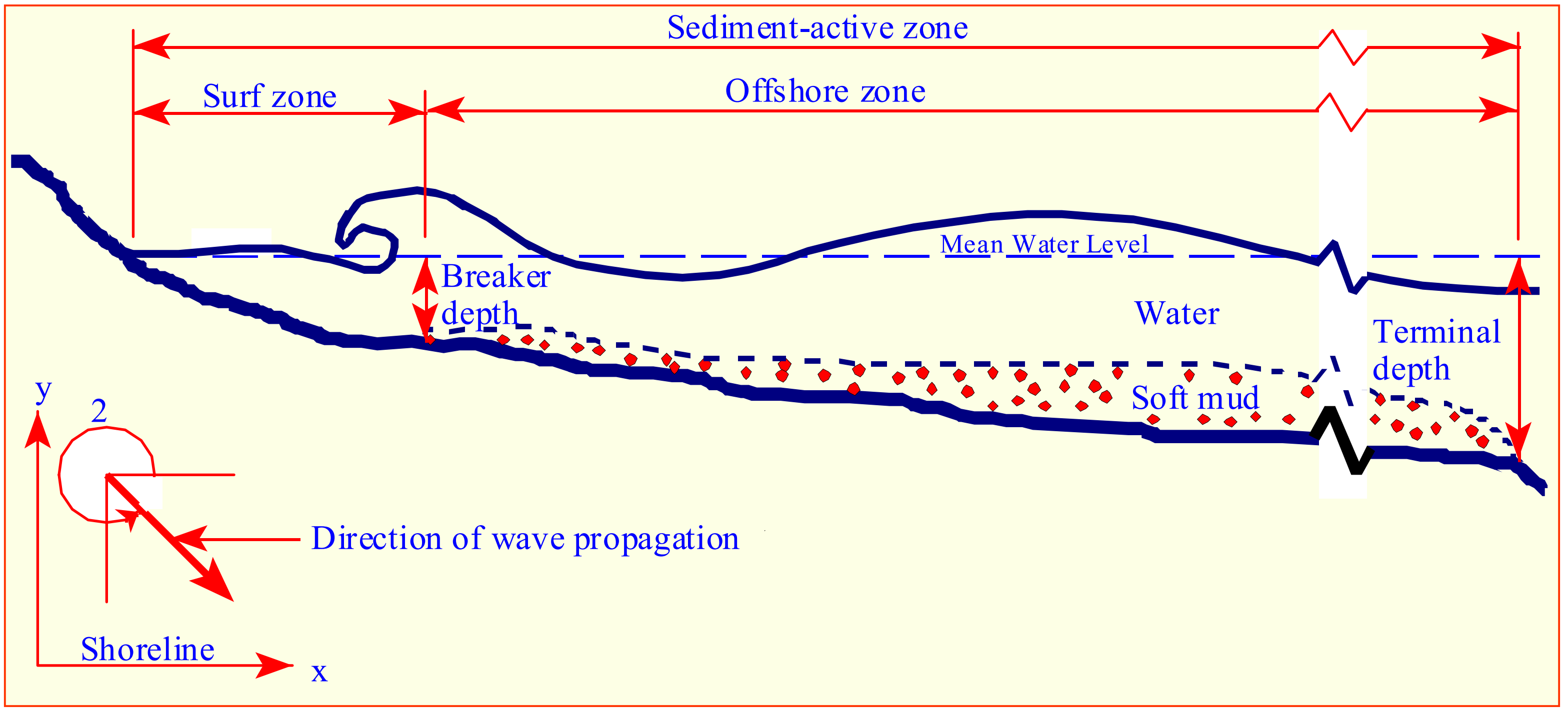

Figure 2 Definition sketch of muddy coast profile and wave approach.

A case in point is the erosion of a glacial till beach at Grimsby along Lake Ontario:

Figure 3 The beach eroded between 1980-84, and the scoured sediment went offshore. As result the shoreline retreated.

Some simple techniques in numerical modeling that remain diagnostic have been developed:

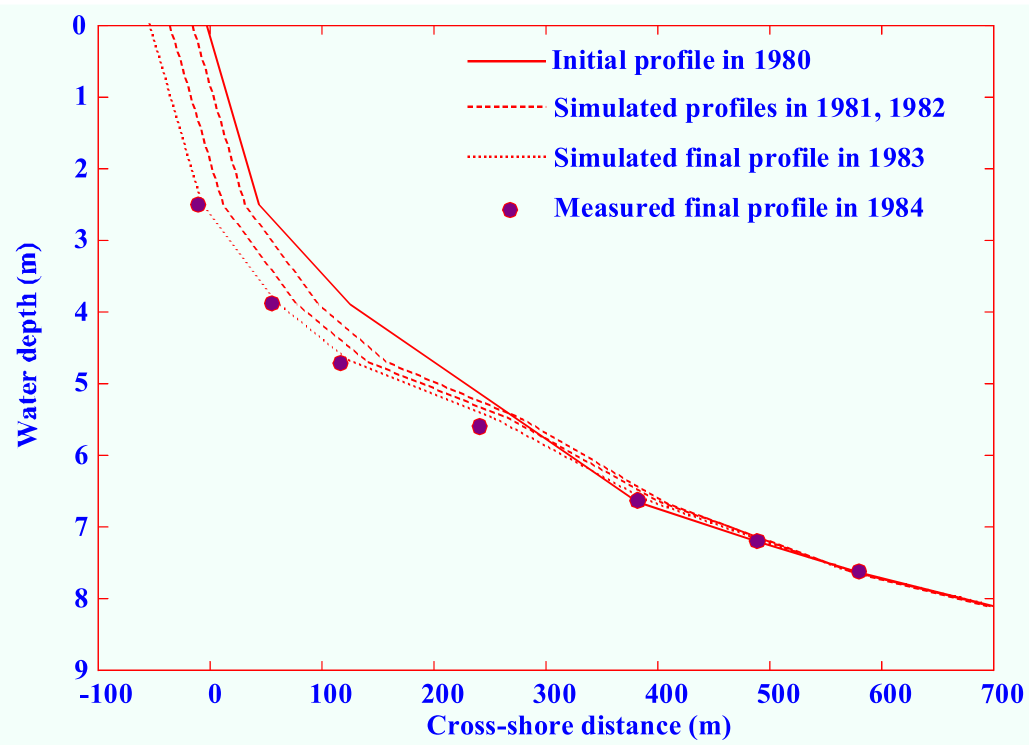

Figure 4 Modeled and measured progression of shoreline retreat along Lake Ontario.

The shoreline near the village of Awoye in Nigeria eroded rapidly 1972-1991 due to canal construction.

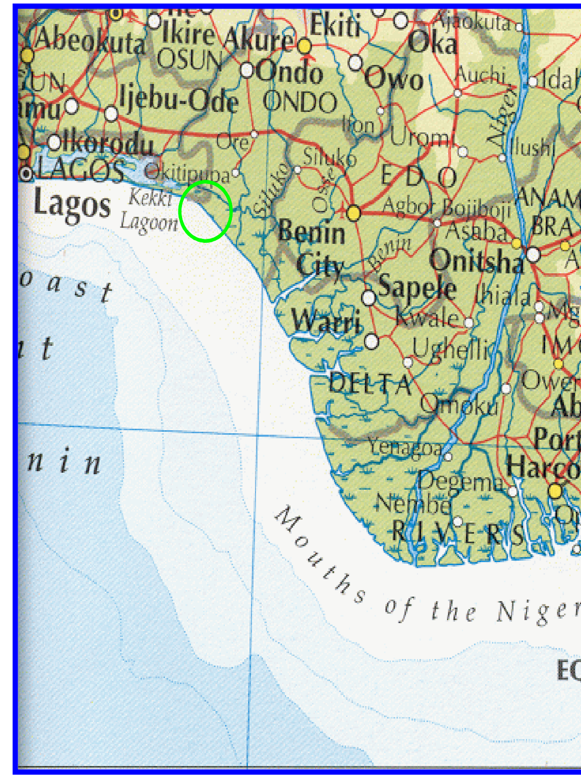

Figure 5 There is no littoral drift in the study area due to removal of sediment by submarine canyons.

This is an example of the need for understanding regional sediment dynamics:

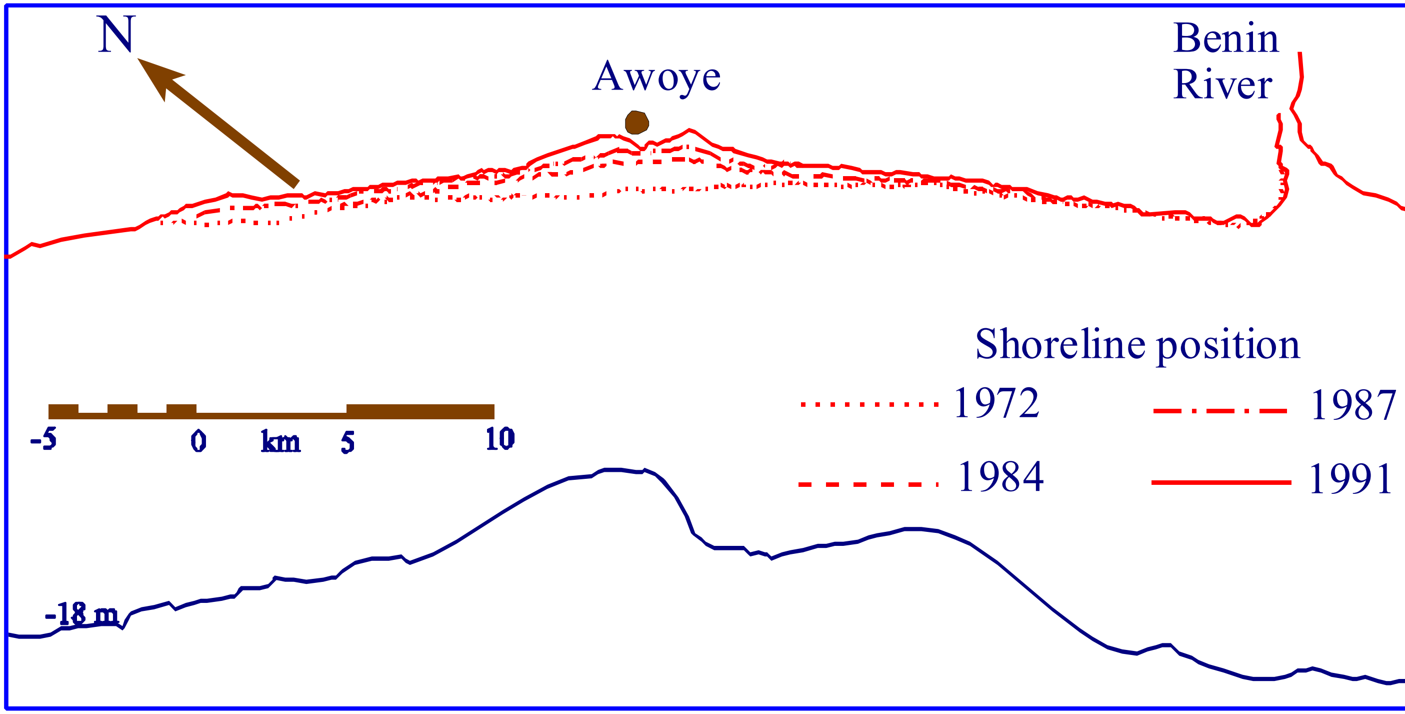

Figure 6 The shoreline near Awoye retreated over 2 km.

Numerical modeling of such a phenomenon requires knowledge of cross-shore as well as alongshore sediment fluxes. Even then, modeling is complicated by a lack of information on the wave climate.

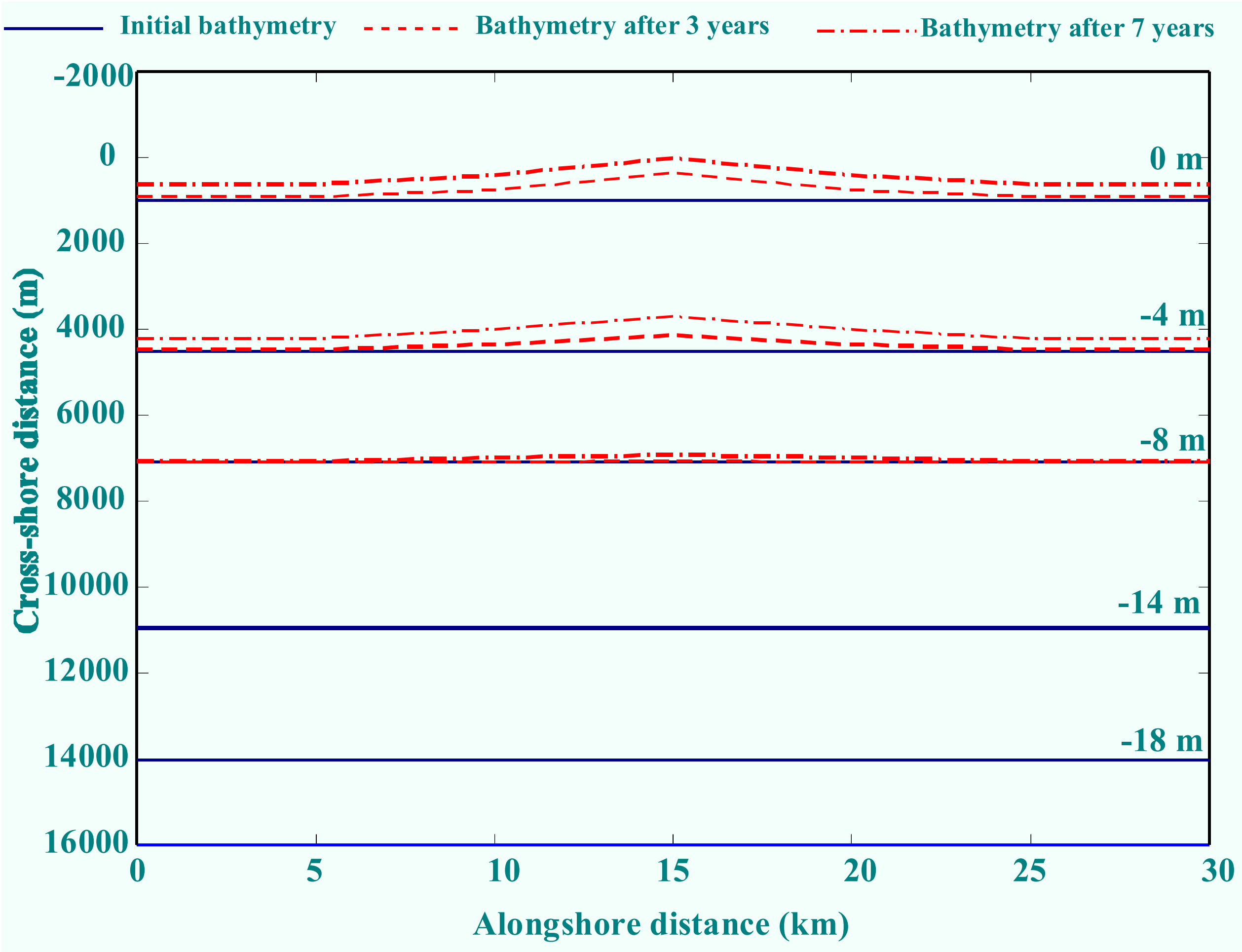

Figure 7 Model is able to qualitatively reproduce large-scale featyres of shoreline retreat only.

Modeling fine sediment transport in wetlands is difficult, especially due to the complexity of transport in vegetated areas.

Figure 8 Salt marsh on Cedar Key, Florida.

A case in point is modeling the impact of relative sea level rise. For a given rise, what will be the configuration of the shoreline? Will it be determined strictly by inundation of existing topography? Or will shoreline processes intervene? What will be the role of built infrastructure?

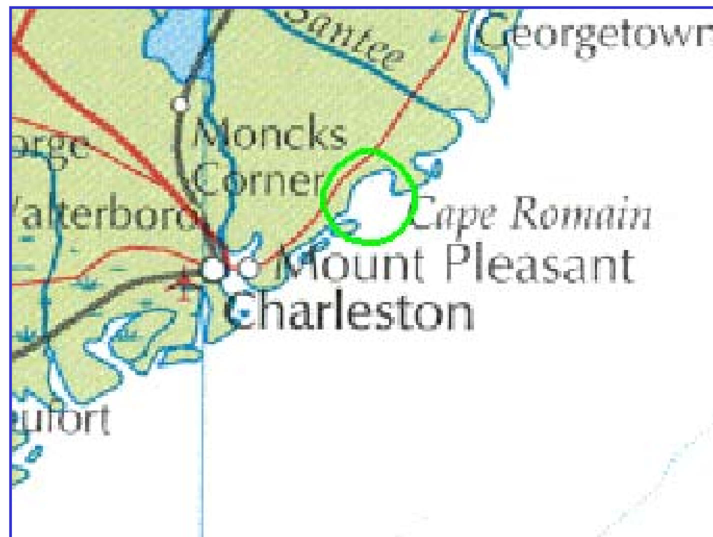

Figure 9 Consider the low-lying wetland in offshore of the town of McLellanville, SC. in the Cape Romain area.

The survival of the salt marsh as the sea level rises is an issue that is tied to the projected rate sedimentation. The Intracoastal Waterway (Mathew's Cut) will most likely remain protecting by levees, thereby limiting the loss of land.

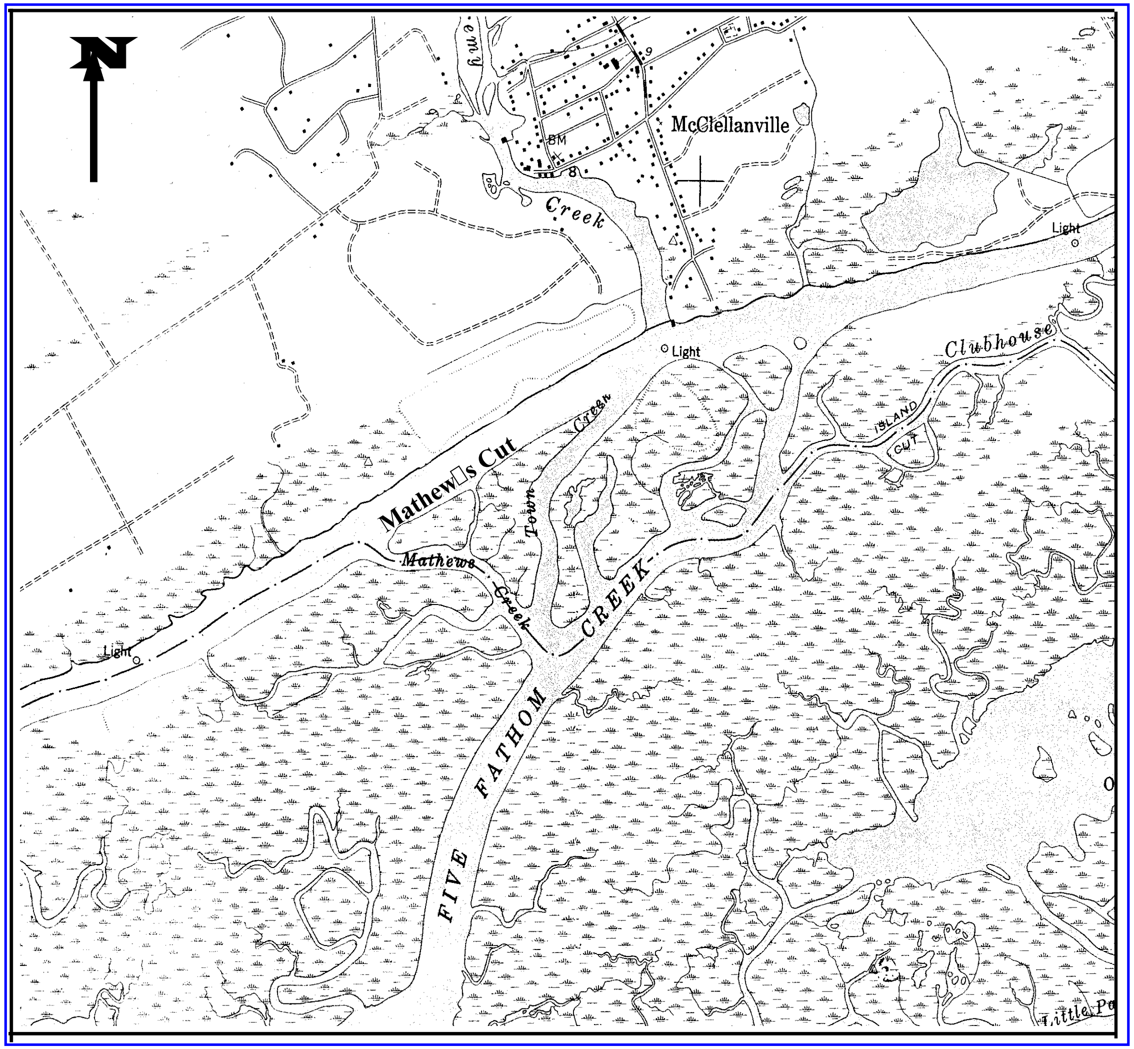

Figure 10 Low-lying salt marshland Intracoastal Waterway near McLellanville, SC.

Estimates of land area lost (hectares) for the Cape Romain area

Sea level rise scenario	Land loss, year 2050 (ha)		Land loss, year 2100 (ha)	
	Static inundation	With effects of biophysical factors	Static inundation	With effects of biophysical factors
Low	5,920 (43%)[a]	Minor	7,420 (56%)	Minor
Moderate	7,130 (54%)	1,510 (12%)	7,960 (66%)	3,370 (26%)
High	7,720 (59%)	2,340 (18%)	8,540 (66%)	5,420 (41%)

[a] Percent of total wetland area in hectares lost relative to present.

Consider estuaries. Developing sediment budget on an estuarywide basis is often essential for looking at local problems, e.g., as in the Loxahatchee River estuary on the Atlantic Coast of Florida.

Figure 11 In order to determine the causes of sedimentation in the central bay of the Loxahatchee River estuary, it is essential to know sediment.

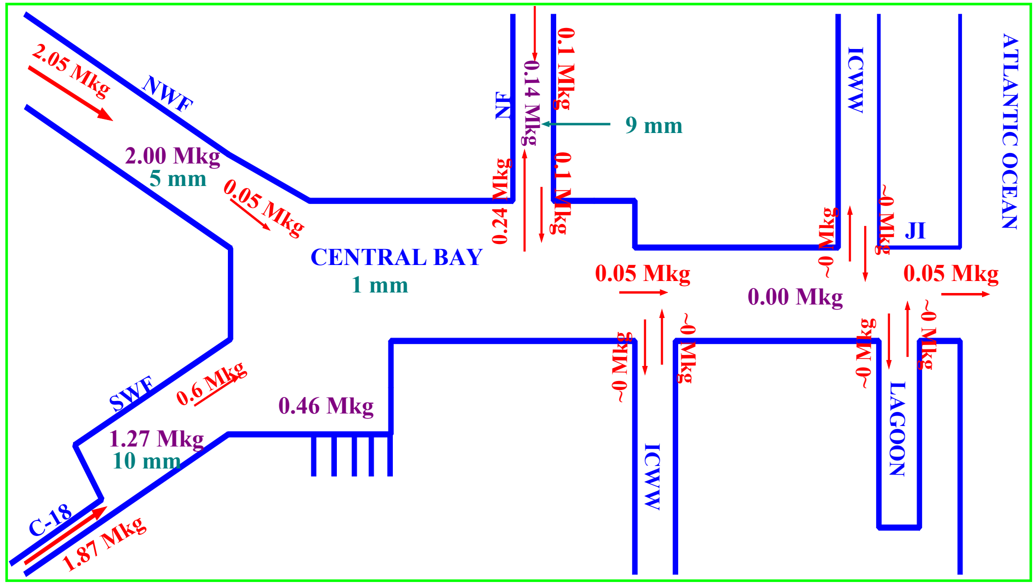

Figure 12 Available data have been used to develop a crude fine sediment annual budget.

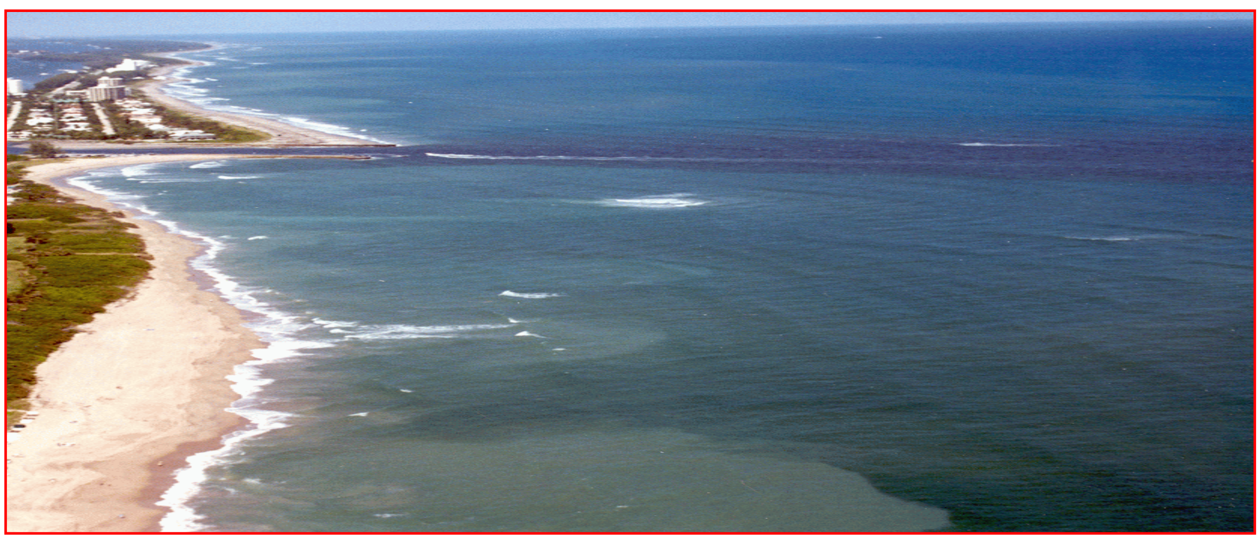

Figure 13 Shows ebb plume containing fine organic detritus out of the Loxahatchee River. The annual rate of outflow is unknown.

To improve the presently developed sediment budget, measurements of sediment transport in the Loxahatchee River estuary are planned. Both sediment suspended load and bedload will be measured for a period of one year at selected locations.

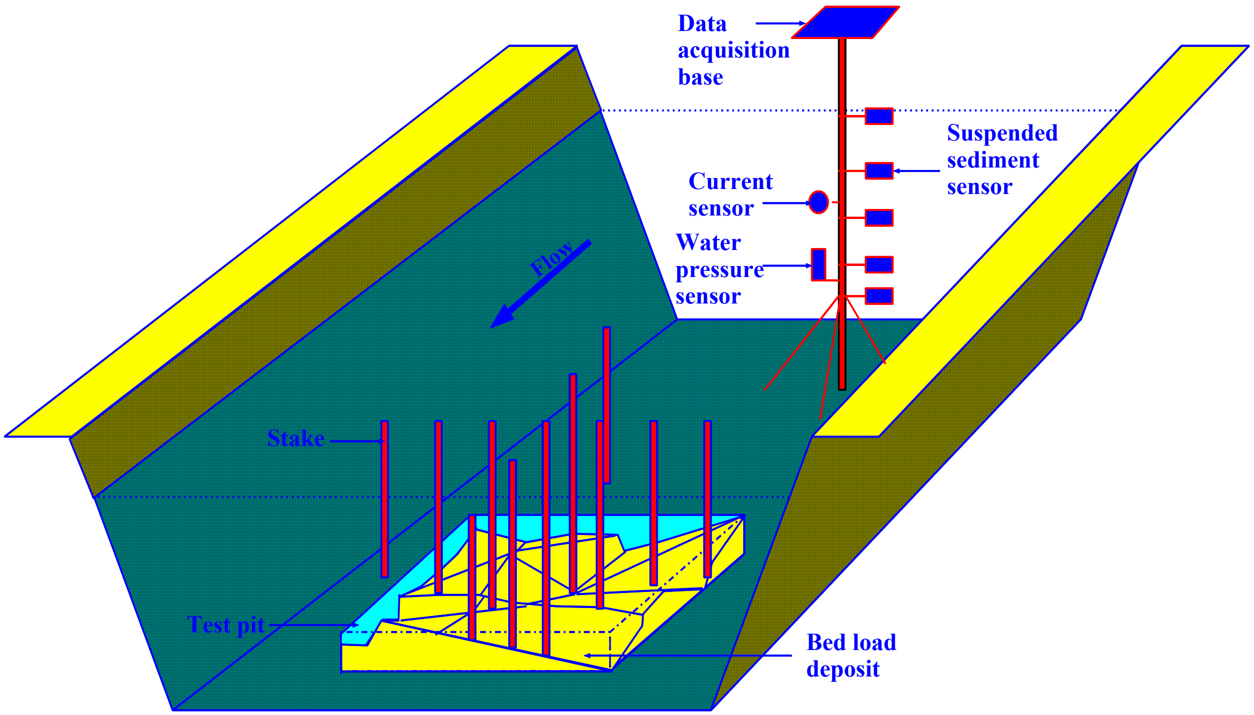

Figure 14 Schematic of sediment measuring arrangement in the Loxahatchee. Suspended load will be measured by a tower assembly, and bed load in a trap (test pit).